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(54) A RADIAL FILTER HAVING A SUPPORT TUBE

(71) We, PUROLATOR FILTER G.m.b.H., of D-711 Ohringen, Schleifbachweg 45, Germany; A German Body Corporate, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to a radial filter having a support tube and a method of producing such, and more especially to a radial filter having an internal support tube having an apertured wall.

In gas and liquid filters for internal combustion engines, a radial filter is used which consists of pleated filter paper rolled-up into a cylindrical form. The filter element in such filters is traversed externally to internally by the medium to be filtered and must therefore be supported on a support tube which has wall apertures therein allowing the passage of the filtered medium therethrough.

In radial filters of this kind mass production is involved and it is therefore desirable and the object of the invention to provide a support tube of the kind referred to above made in such a manner that the tube can be produced with a minimum of material and labour costs.

According to the present invention there is provided a radial filter having at least one support tube made from a blank of stiff foil material rolled up about a central axis, the blank being cut to provide the tube with an apertured wall formed by a web extending along the length of the tube with a plurality of axially spaced apart parallel sided arms extending from the web at right angles to the said axis and forming the remaining wall portions of the tube.

In known support tubes of radial filters, material waste is caused in providing the necessary wall apertures. This, however, is readily avoided with the present invention because the incisions of one blank may form the arms of an adjacent blank.

Advantageously, the arms are of the same shape and dimensions as the axial gaps between them. Thereby, the interengaging arms and gaps of adjacent blanks are also of equal size by means of which the manufacture in large quantities of uniformly formed blanks is facilitated, only a small amount of waste being formed at the axial ends of the blank.

Preferably the blank is made of corrugated sheet material the corrugations extending in substantially the same direction as the longitudinal direction of the arms. The corrugated structure serves on the one hand, to reinforce the internal support tube and, on the other hand, promotes the rate of passage of the filter medium in the region of the webs. This latter effect takes place because of the corrugated structure which ensures that there is only spot contacts between the webs and the fold edges of the radial filter.

The invention also provides a method of producing a radial filter having a support tube, having the axial spacing between adjacent arms equal to their width, wherein a said blank, conforming to the developed shape of the tube wall, is stamped out of a length of strip material along incisions such that the arms are parallel to the length of the strip and, when the blank has been severed from the parent strip, the gaps left in the end of the parent strip define the corresponding arms of an inverted identical blank for a further tube.

In radial filters, support tubes are used internally or externally whilst in others both an internal and an external support tube are provided. Radial filters having filter elements with support tubes arranged as mentioned are intended to be within the

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scope of the present invention.

The invention will be further described, purely by way of example, with reference to the accompanying drawings, in which:—

Figure 1 shows in perspective, the broken-off upper end of a radial filter which is supported by means of an internal support tube in accordance with the present invention.

Figure 2 is a perspective view of the internal support tube shown in Figure 1,

Figure 3 shows a strip of foil material with a template used for stamping blanks for forming the internal support tubes shown in Figure 2,

Figure 4 is a filter material section showing the template for blanks for forming support tubes of an alternative configuration and

Figure 5 shows schematically a production line for producing blanks for support tubes in accordance with the invention.

In Figure 1, there is shown a radial filter 1 made from porous filter paper which is pleated. The paper is rolled up into a cylinder jacket and accommodated in a filter housing. The medium to be filtered is passed from the exterior to the interior of the radial filter in the direction of the arrow 4, purified medium passing into the interior space 2 of the radial filter, and thence to an outlet which is isolated from the inlet. The radial filter is supported against the radially inwardly acting forces and is directed radially outwardly by means of a rigid internal support tube 3. The internal support tube 3, which is shown in Figure 2, is provided with wall apertures 5 to 7, through which the filter medium can pass to reach the internal space 2.

The support tube of Fig. 2 is made from a blank 8 of sheet metal, but may also be made of other stiff foil material such as plastics or even cardboard. The blank is cut along pairs of incisions 11 to 16 joined together at their ends to form a web 30 extending axially along the length of the tube with pairs of arms 17 and 21, 18 and 22, 19 and 23 and 20 and 24 axially spaced apart with the arms of each pair level with one another and extending at right angles to the central axis 27 of the tube on either side of the web. In the embodiment illustrated the ends 52 and 53 of each pair of arms remote from the web are secured together as by spot welding at 31. A stiffening rib 32 extends axially along the web 30 but not completely to its ends. The material of the tube is corrugated, as shown at 29, with the corrugations extending parallel to the arms 17 to 24. The corrugations reinforce the internal support tube with respect to the radially directed loading forces and permits only point contact between the internal fold edges, for example, the fold edge 33 of the radial filter 1 and the internal support tube 3. The axial spacing between adjacent arms is equal to their width, while, in the embodiment illustrated, all the arms are of equal length, which enables the blank 8 to be stamped out of strip material with a minimum of waste, as will now be shown with reference to Fig. 3.

In Fig. 3 a straight parallel sided piece of strip material 26 is shown with stiffening ribs 32 embossed in the strip along the dotted lines 25 at right angles to the length of the strip and at regular intervals therealong. The corrugations 29 of Fig. 2 are not shown in Fig. 3 for the sake of clarity. Continuous incisions 11 are shown in Fig. 3 extending to and fro from the top edge to the bottom edge of the strip 26 symmetrically on either side 9 and 10 of the dotted lines 25, to define pairs of arms parallel to the strip edges. These incisions correspond to the pairs of incisions 11 to 16 of Fig. 2. To form identical blanks, such as the blank 8 of Fig. 2, small pieces of material, shown hatched as at 34 and 35, are additionally cut out.

These small pieces at the top and bottom edges of the strip are the only pieces of waste material formed in the production of successive identical blanks. As will be seen from Fig. 3, when a blank 38 is severed from the strip along the incision 11, the gaps left in end of the parent strip define the arms on one side of the central web of the blank 8, and when the blank 8 is severed the arms of a further blank 36 are formed. Fig. 3 thus shows the formation of complete blanks 8, 36 and 37 with broken away portions of adjoining blanks 38 and 39 at the ends of the piece of strip material. The blanks are identical, each being inverted with respect to the immediately preceding one.

Figure 4 shows an alternative form of blank, in which arms 41 are formed only on one side of webs 44. A blank 42 so formed is rolled up into a cylinder around an axis 43 which is at right angles to the longitudinal extension of the arms 41. The free ends of the arms may be connected to the web 44 of the blank by any suitable method such as spot-welding. The arms 41 have the same shape and dimensions as the incisions 40, so that the arms of an adjacent blank 45 fit into the incisions. However, the second blank has a reversed orientation with respect to the first. The blanks, as shown by the reference numerals 42 and 45, may be stamped out in pairs from a foil strip 46. Again, only small pieces of waste occur along the edges of the foil strip, for example, the waste piece

47, which again is shown by hatching in Figure 4 since the arms of one blank interdigitate with the arms of the adjacent blank.

The incisions 48 and 49, providing web edges, are at right angles to the arms 41, as in Figures 2 and 3, providing cylindrical support tubes. However conical support tubes may conveniently be formed by inclining the web edges to the arms, as indicated by the broken lines 50, 51 the arms 41 still being of equal length. In such a case, each pair of adjacent interdigitating blanks has a trapeziodal outline and identical blanks are formed without additional stamping waste. Such conical internal support tubes may also be produced from a wall blank 8 having a web of constant width if the ends of the arms are allowed to overlap more in one of the end regions of the tube. Due to this greater overlap, more material is used to produce a tube having identical dimensions to that shown in the embodiment utilising a web of tapering width formed by an inclined incision as shown by the broken lines 50 and 51 of Figure 4.

In a modification of the embodiments described, the connection at the ends of the arms may be dispensed with and the ends may be allowed to be in a loose arrangement relative to one another and, in certain circumstances, may even have a spacing therebetween. Connection of the ends is, however, preferred because the connections of the ends results in a greater resistance of the support tube to the radial forces.

Figure 5 shows a bobbin 70 from which sheet metal strip 73 is drawn in the direction of the arrow 71. The sheet metal strip 73 arrives at an embossing device 72 in which it is embossed with a corrugated structure 74, the corrugations of which extend in the longitudinal direction of the strip, i.e. the direction of arrow 71. Subsequent thereto, the strip arrives at a creasing device 75 in which longitudinal ribs are embossed at predetermined intervals in the blank, which embossings correspond to the longitudinal rib shown in Figure 2. Thereafter, the sheet metal strip 73 is transported to a stamping device 78 in which, in accordance with the outlines shown in Figure 3, the blanks 79 are stamped. The blanks 79 are then removed on a conveyor device 80 to be rolled into a closed support tube and then welded. The drives of the bobbin 70, the embossing device 72, the rib-forming device 75 and the stamping device 78 are denoted by the reference numerals 81 to 84. These may, as indicated in chain-dotted lines, be connected to a central control device 85 for mutual synchronisation.

WHAT W CLAIM IS:—

1. A radial filter having at least one support tube made from a blank of stiff foil material rolled up about a central axis, the blank being cut to provide the tube with an apertured wall formed by a web extending along the length of the tube with a plurality of axially spaced apart parallel sided arms extending from the web at right angles to the said axis and forming the remaining wall portions of the tube.

2. A radial filter as claimed in claim 1 wherein the said arms extend from the web in axially spaced apart pairs, the arms of each pair being level with one another on opposite sides of the web.

3. A radial filter as claimed in claim 1 wherein the ends of the arms of each pair remote from the web are secured together.

4. A radial filter as claimed in claim 1 wherein the arms extend from one side only of the web and the otherwise free ends are secured to the web.

5. A radial filter as claimed in claim 1 of conical shape, wherein the web is tapered in width from end to end but the arms are all of equal length.

6. A radial filter as claimed in any preceding claim wherein a stiffening rib extends axially along the said web from adjacent its ends.

7. A radial filter as claimed in any preceeding claim wherein the foil material is corrugated with the corrugations extending substantially parallel to the arms.

8. A radial filter as claimed in any preceding claim, wherein the said material is sheet metal foil.

9. A radial filter as claimed in any preceding claim wherein the axial spacing between adjacent arms is equal to their width.

10. A method of producisg a radial filter having a support tube as claimed in any of claims 1 to 9, wherein a said blank, conforming to the developed shape of the tube wall, is stamped out of a length of strip material along incisions such that the arms are parallel to the length of the strip and, when the blank has been severed from the parent strip, the gaps left in the end of the parent strip define the corresponding arms of an inverted identical blank for a further tube.

11. A method as claimed in claim 10, wherein the strip material prior to stamping is embossed with corrugations as specified in claim 7.

12. A radial filter having a support tube made by the method claimed in claim 11 substantially as hereinbefore described with reference to and as illustrated in Figs. 1 and 2 of the accompanying drawings.

13. A method of producing a radial filter having a support tube from a blank

substantially as hereinbefore described with reference to and as illustrated in Figs. 3 or 4 together with Fig. 5 of the accompanying drawings.

14. A radial filter having a filter element and a support tube substantially as herein described with reference to and as illustrated in the accompanying drawings.

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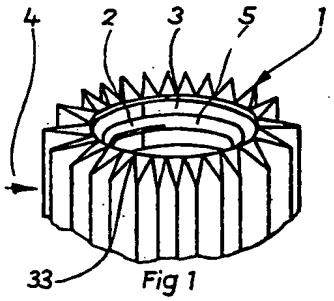

Fig 1

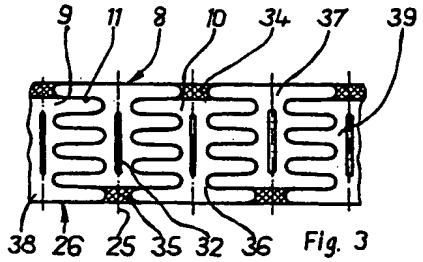

Fig. 3

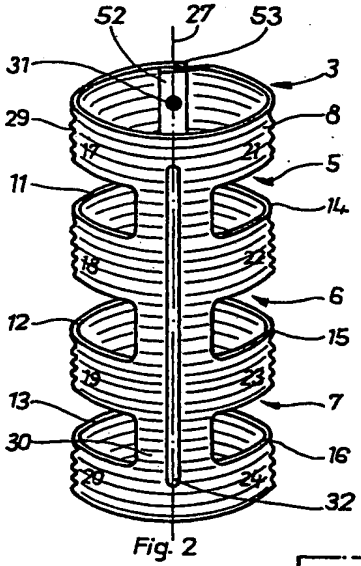

Fig. 2

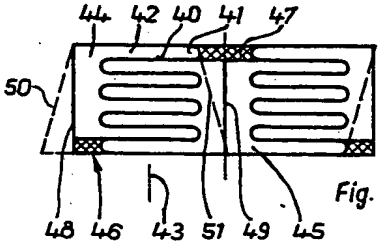

Fig. 4

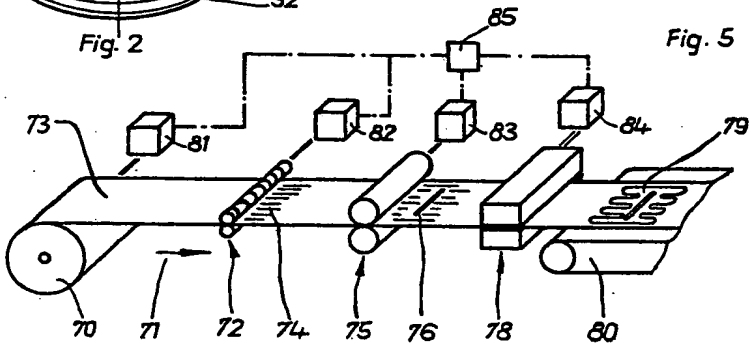

Fig. 5